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Outline on chap. 4 (Henney's)

Detection of Amplitud Modulated Signals

- I. Modulation.
  - A. Reasons for modulation:
    - 1. Audio frequencies can't be transmitted through the air.
    - 2. Must be combined with am R.F. carrier.
  - B. Definition:
    - 1. Process of changing some characteristic of an R.F. carrier wave, by an A.F. wave, so that it retains the ability to be radiated but contains the audio frequency.
  - C. Types:
    - 1. Frequency modulation: (FM) The A.F. causes the frequency of the R.F. to change above and below it's normal value.
    - 2. Phase modulation. (PM) The A.F. causes the phase angle of the R.F. wave to vary at an audio rate.
    - 3. Pulse modulation. The R.F. carrier wave may be sent out in short spaced pulses. The A.F. can vary the spacing and height of these pulses.
    - 4. Amplitud modulation. (AM) The A.F. causes the R.F. wave amplitud to vary at an audio rate.
      - a. The process of AM has caused the maximum value of the carrier wave to change.
      - b. The degree of change is difined as percentage modulation.
      - c. The AM carrier consist of three frequencies. (1). The carrier frequency. (2). The sum of the carrier fr. and the A.F. called the upper side band. (3). The diference of the carrier fr. and the A.F. called the lower side band.
- II. Demodulation or detention of AM signals.
  - A. Definition:
    - 1. The process of removing the A.F. from the carrier wave.
  - B. Steps in detection of AM signals.
    - 1. Rectification. One half of the modulated wave is cut off.
    - 2. Filtering. The R.F. voltages retaining the amplitud variations.
    - 3. Removal of any D.C. component.
- III. Types of AM detectors: Linear and Square-Law.
  - A. Linear detectors employ complete rectification operating with a straight line as the characteristic curve.
    - 1. The detector is biased at cut-off.
    - 2. The output consists of half the carrier wave with the amplitud variations.
    - 3. The average value of the R.F. peaks will be the average value of the A.F.
  - B. Square Law Detectors.
    - 1. Square law detectors employ partial rectification, operating on the non-linear part of the characteristics curve.
    - 2. Since the detector is biased before cut-off more current is passed on the positive half cycles than on the negative.

3. The average value of the output current contains the original AF. signal.
4. The output contains of the A.F. signal therefore distortion is introduced.

IV. Filtering the detector output.
   - A. Elimination of the R.F. current.
      1. Using an R.C. time constant in the load of the detector to by-pass the R.F. current to ground.
      2. The value of the capacitor must be such that it will smooth out the high R.F. but not the low A.F.
      3. Formula to find the right values: $R\,C = \frac{1}{2\pi FmM}$
         Where Fm is the maximum A.F.
         and M is the highest percent of modulation in the signal.
   - B. The output contains the A.F. and a D.C. component which is eliminated by a D.C. blocking capacitor in series with the output.

V. Crystal Detector.
   - A. Advantages:
      1. Used mostly for high fr. since the interelectrode copacitance is very low.
      2. No filament voltage needed.
   - B. Used either as linear or square law depending on the applied voltage and load resistor.

VI. Diode detector.
   - A. Advantages:
      1. More stable than crystal.
      2. Less distortion if properly operated.
   - B. Disadvantage:
      1. Draws current from input circuit in positive cycles decreasing the selectivity of the tunned circuit.
   - C. If the load resistor is high, it helps reduce the power drawn and the distortion.
   - D. The load resistor is usually made many times the resistance of the tube.
   - E. Coupling of the audio voltage.
      1. Mostly done by R.C. coupling.
      2. This could cause distortion since the effective load will consist of the total parallel resistance of the grid resistor of the next tube and the actual load resistor.
      3. One method of to reduce this distortion is by using a variable resistor for the load, and using the tapped voltage as the input to the audio amplifier. This effectibly reduces the loading caused by the grid resistor.

VII. Plate detection.
   - A. Advantages:
      1. For strong signals it operates as linear detector.
      2. Provides amplification and has high sensitivity.
   - B. Disadvantage:
      1. Tube biased for class B operation.
      2. More distortion since it operates in the curvature of the characteristic curve.

3. For weak signals it will produce square law detection.

C. The output is taken from the plate load.

D. The R.F. is bypassed by a capacitor from plate to ground.

VIII. Infinite input impedance detector.

A. Essentially the same as the cathode follower except that the cathode resistor is made verylarge.

B. Advantages:

1. It has a very high input impedance, therefore it does not imposes a load to the input circuit.

2. It will operate satisfactorily for widely varying levels of input signal.

C. Disadvantage:

1. The signal must be a few volts to prevent square law detection and distortion.

IX. Grid leak detection.

A. Detection is obtain in the grid circuit, an the signal is amplified in the plate circuit.

B. It operates in the curvature of the grid-voltage-grid-current and it detects by square law action.

C. The plate should operateon it's linear portion. This requires low plate voltage.

D. The grid leak resistor is made very high so that the flow of grid current will produce the operating bias and so that the input impedance will be very high.

E. The capacitor across the grid resistor filters out the R.F. variations.

F. Advantages:

1. Small amplification is obtain.

2. More sensitive than the plate detector.

G. Disadvantage:

1. More distortion than the diode.

2. Has limited power handling ability.

X. Automatic volume control. (A.V.C.)

A. Controls the gain of a receiver automatically.

B. When the incoming signal is strongAVC reduces the gain and when the incoming signal is weak AVC increases the gain to maximum value.

C. AVC uses the DC voltage developed in the diode detector. This voltage is taken from the negative end of the diode load resistor and is fed back to the RF and IF stages. This negative is filtered to get rid of the AF variations.

D. If a strong signal arrives at the detector, more voltage is developed across the load. This increase will be fed back as a negative bias to the RF tubes cutting down the gain.

E. The AVC tubes must be of the variabla mu kind

XI. Manual volume control.

A. To control the audio fed to the loud-speaker.

B. Methods:

1. By taking more or less audio from the output of the detector.

2. By increasing or decreasing the bias to the RF or IF tubes.

3. Varible resistors are not usually used in the RF or IF stages because they introduce noise. The most common volume control is the one used in the audio stage.